



Beyond Bouncing Back: A Roundtable on Critical Infrastructure Resilience

Vivien Li

The Boston Harbor Association

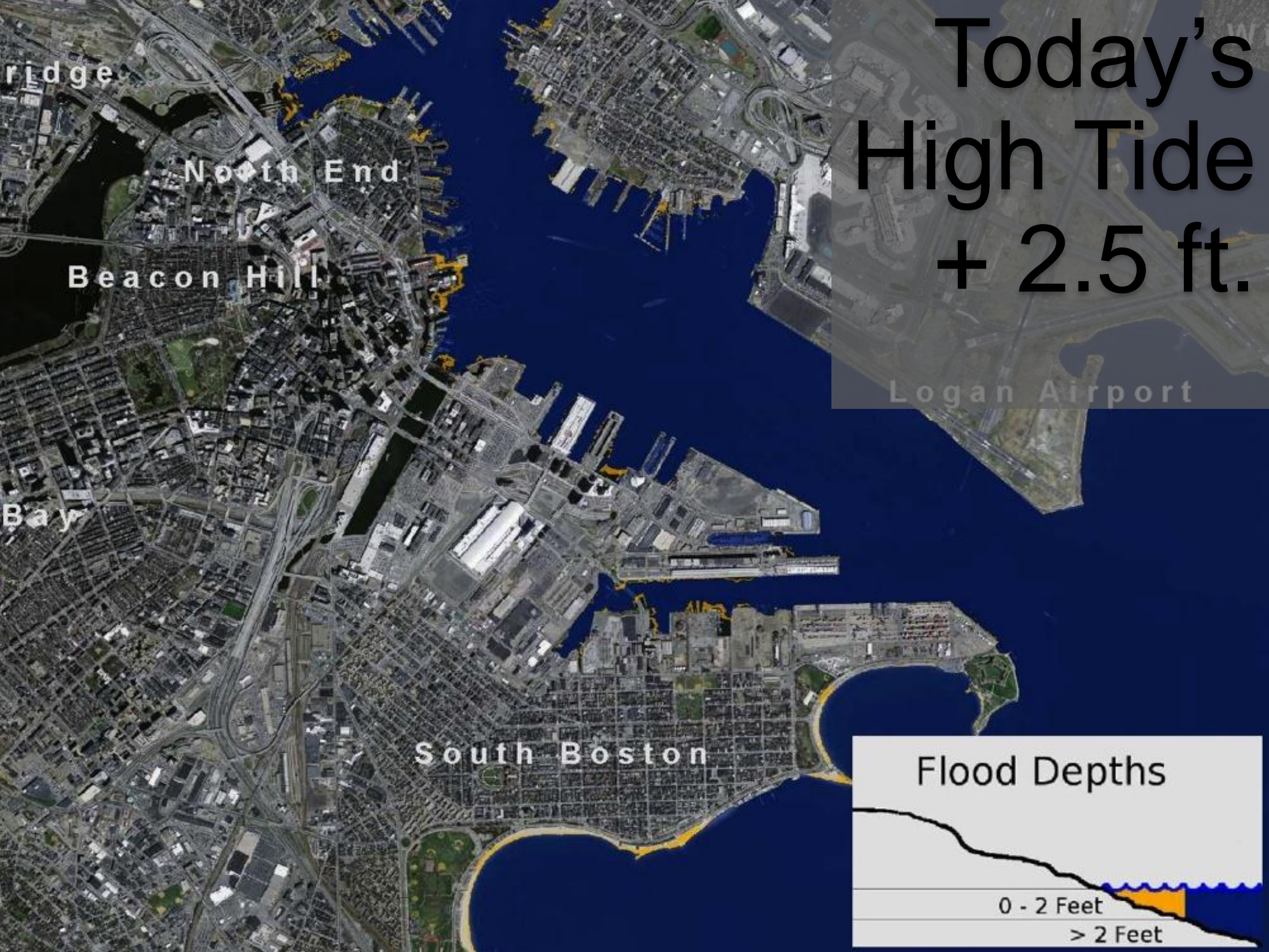
Tuesday, April 30, 2013

Preparing For The Rising Tide

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Preparing For The Rising Tide

- Identifies Boston's vulnerability to larger storms and higher floods
- Encourages property owners and public agencies to know and decrease risks
- Supports flexible, co-benefit, cost-effective solutions



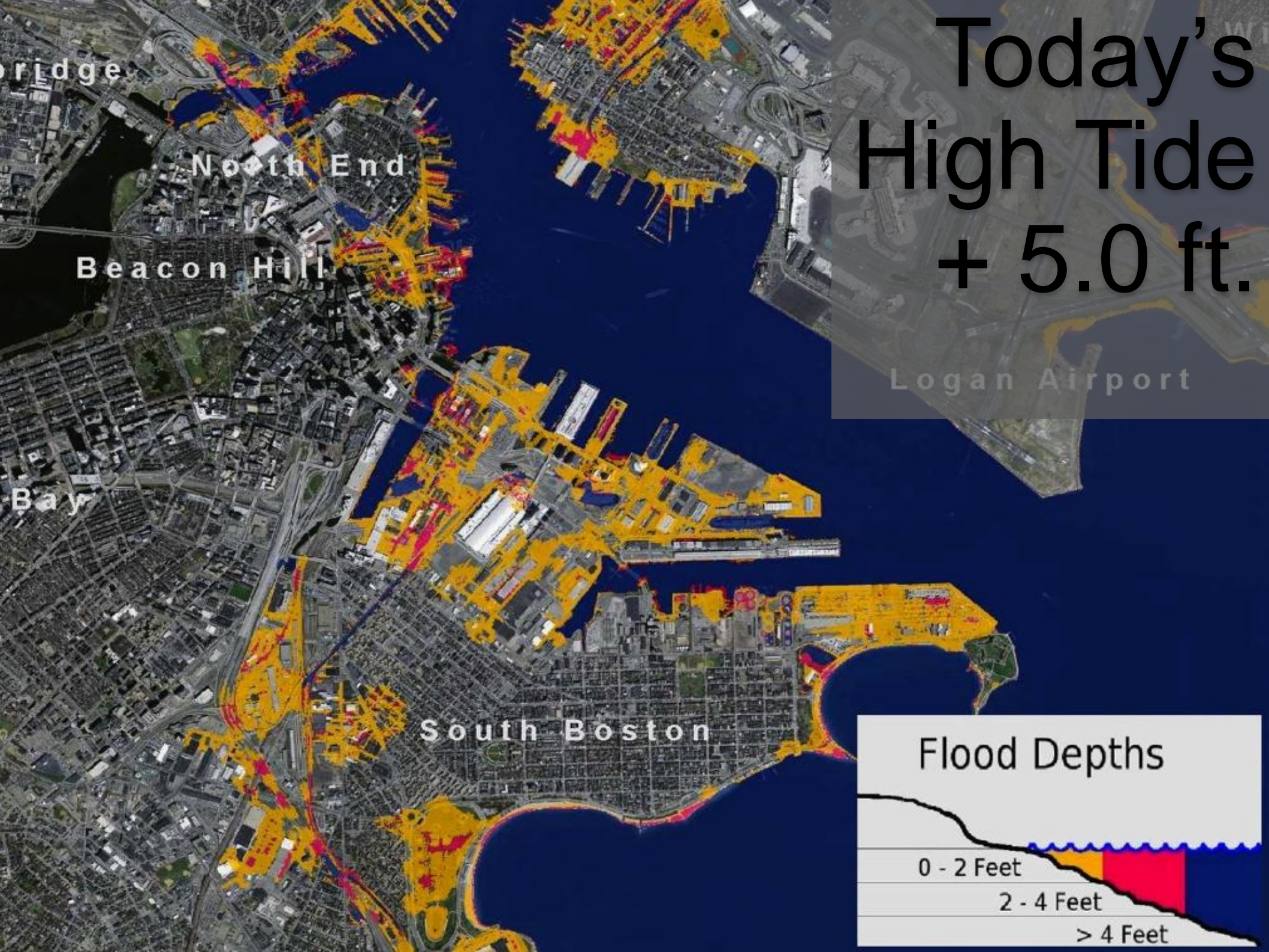
Today's
High Tide
+ 2.5 ft.

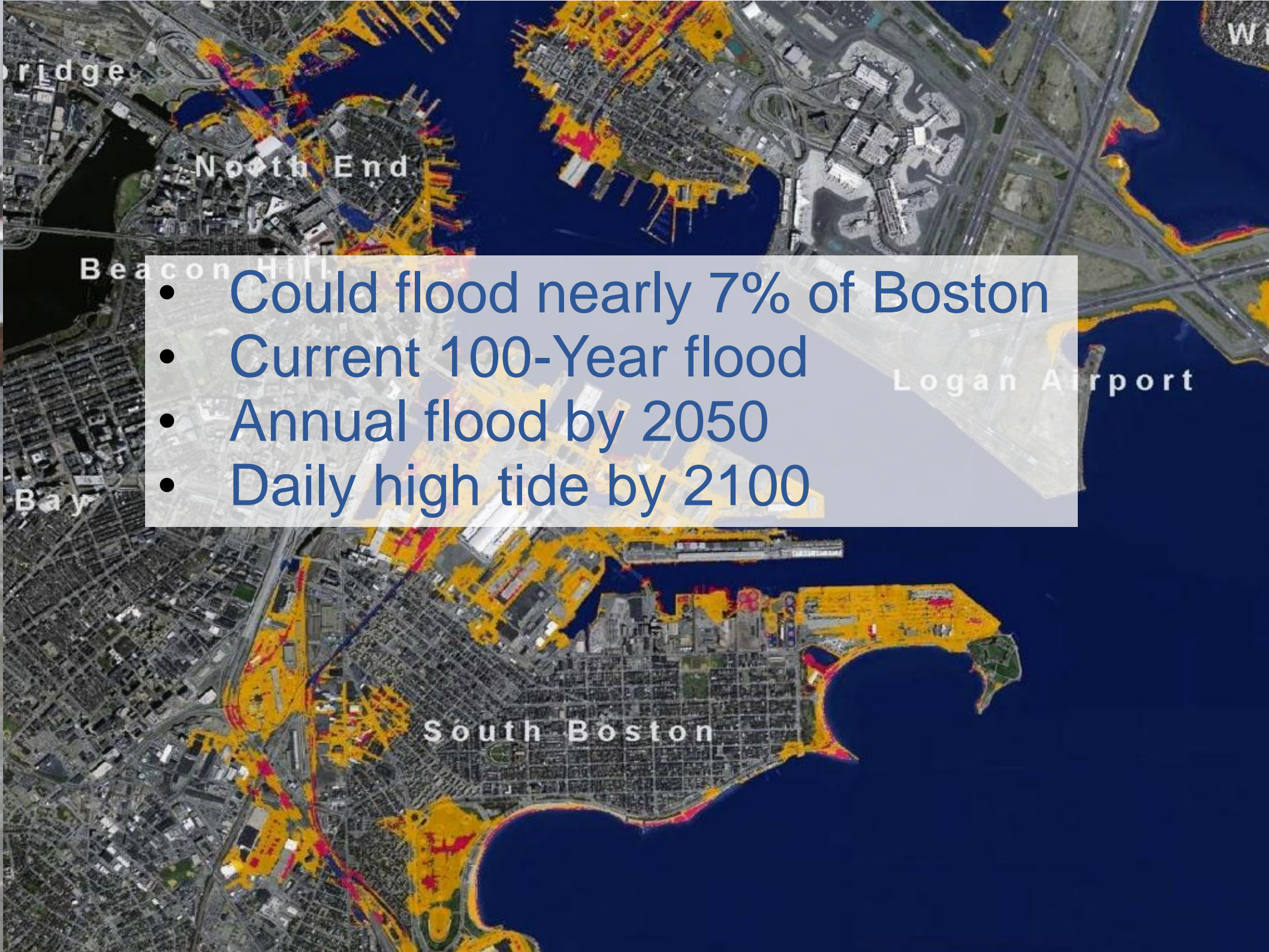
Logan Airport

Flood Depths

0 - 2 Feet

> 2 Feet



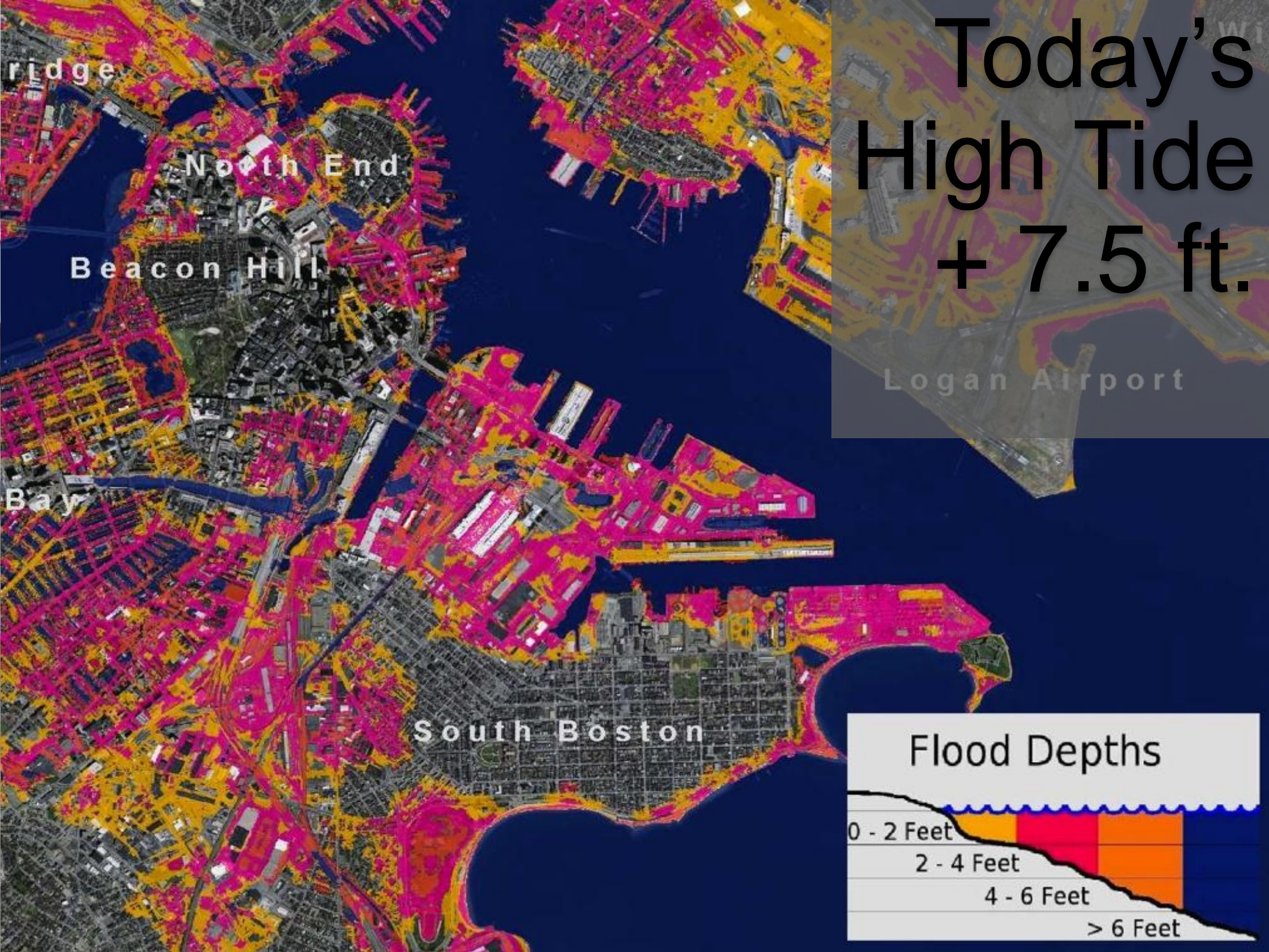


- Could flood nearly 7% of Boston
- Current 100-Year flood
- Annual flood by 2050
- Daily high tide by 2100

Who's At Risk



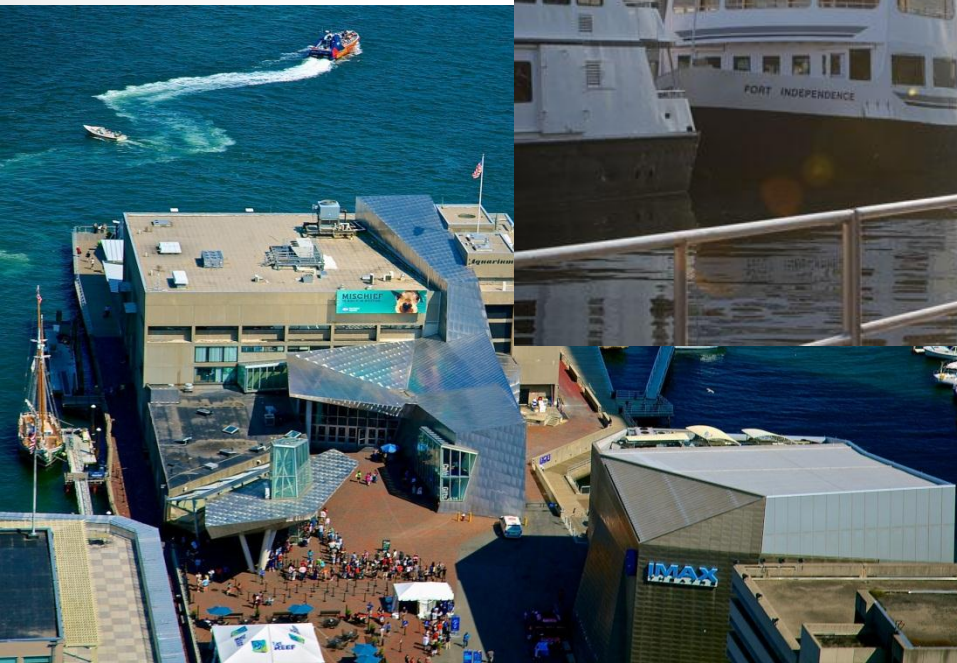
Today's High Tide + 7.5 ft.





- Could flood over 30% of Boston
- 100-year flood by 2050
- Annual flood by 2100

What Would Flood?



What Would Flood?

Table 6. Ownership of ten largest parcels flooded at MHHW+7.5 (12.3 ft NAVD)

Land Use Category	Total Area (in million sq. ft.)	Site Name	Owner	Address
Exempt	101.6	Logan Airport	Massport	Maverick Street
Exempt	7.2	Marine Industrial Park	Economic Development and Industrial Corporation	600 Summer Street
Exempt	4.5	Conley Terminal	Massport	20 Farragut Road
Exempt	2.7	Harvard Stadium	Harvard University	69-79 N. Harvard Street
Residential	1.9	Harbor Point Apartments	Harbor Point Apts. Co Lessee	400-260 Mt Vernon Street
Exempt	1.6	Black Falcon Cruise Terminal	Massport	666R Summer Street
Exempt	1.3	Curley Community Center	City of Boston	William J Day Boulevard
Exempt	1.3	Boston Autoport	Massport	Terminal Street
Exempt	1.2	MBTA Maintenance Facility – Orient Point	MBTA	1023-1081A Bennington Street
Exempt	1.1	Boston Convention and Exhibition Center	Mass. Convention Center Authority	Summer Street

What Can We Do?

...

Public Sector

- Accelerate the implementation of Boston's climate action plan
- Survey preparedness of all public buildings and the MBTA
- Include climate prep as a design component for development
- Increase enforcement of flood proofing standards for property owners

Property Owners

- Identify vulnerable structures and systems on your property
- Understand future flood conditions on and around your property
- Implement cost-effective, flexible adaptation plans

Sample Plan

Marriot Hotel/MBTA Aquarium Station

- Three flooding levels projected over time
- What should I care about today?
- When can I expect flooding in the future?

Mean Higher High Water (MHHW) Timeline	Annual (1-year) Storm Surge Timeline	100-year Storm Surge Timeline	Approximate Maximum Water Surface Elevation (ft, NAVD88)	Upland Flooding Potential
			4.0	No Flooding Expected
2010			5.0	
2050			6.0	
	2010		7.0	Flooding of surrounding area and 7.5 ft NAVD entrances to below-ground garage and MBTA station.
	2050		8.0	
			9.0	
		2010	10.0	Flooding of Marriott infrastructure and entire Long Wharf region.
			11.0	
	2050		12.0	Widespread flooding of entire area during storm events. Water arriving into Long Wharf area from other regional sources in addition to local flooding.
			13.0	
		2100	14.0	
			15.0	
			16.0	



What is vulnerable now?

MHHW Timeline	Annual Storm Surge Timeline	100-Year Storm Surge Timeline	Approximate Maximum Water Surface Elevation (ft, NAVD88)	Upland Flooding Potential	Recommended Engineering Adaptations	Estimated Adaption Cost
			4.0	No Flooding Expected	No Action Required	N/A
2010						
			5.0			
			6.0			
2050				No Flooding Expected	No Action Required	N/A
			7.0			
	2010		7.0	Flooding of surrounding area and 7.5 ft NAVD entrances to below-ground garage and MBTA	Develop alternate access route plans. Minor flood proofing.	Minimal
			8.0			
			9.0			
2100	2050			Flooding of Marriott infrastructure and entire Long Wharf region.	See Regional Adaptations (Parapet Wall)	See Regional Adaptations
			10.0			
			11.0			
		2010	10.0	Flooding of Marriott infrastructure and entire Long Wharf region.	See Regional Adaptations (Parapet Wall)	See Regional Adaptations
			11.0			
			12.0			
			13.0	Widespread Flooding of entire area during storm event. Water arriving into Long Wharf area from other regional sources in addition to local flooding.	In addition to adaptations above, flood proofing and elevation of critical infrastructure.	Capital Cost: Estimated \$20 per square foot of building for wet flood proofing.
			14.0			
			15.0			
		2100	14.0	Widespread Flooding of entire area during storm event. Water arriving into Long Wharf area from other regional sources in addition to local flooding.	In addition to adaptations above, flood proofing and elevation of critical infrastructure.	Capital Cost: Estimated \$20 per square foot of building for wet flood proofing.
			15.0			
			16.0			

When will there be flooding?

MHHW Timeline	Annual Storm Surge Timeline	100-Year Storm Surge Timeline	Approximate Maximum Water Surface Elevation (ft, NAVD88)	Upland Flooding Potential	Recommended Engineering Adaptations	Estimated Adaption Cost
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		2050	11.0			
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		2100	15.0			
			16.0			

UMass Boston/Columbia Point

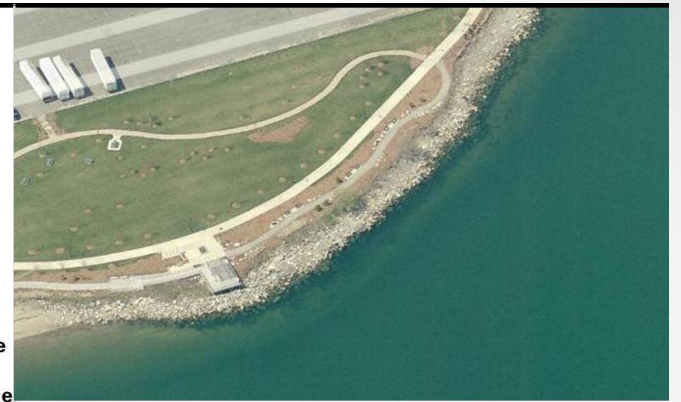
- Bayside Expo
- Current Main Entrance from Morrissey Boulevard
- Proposed 2nd Main Entrance from Mt. Vernon Street



UMass Boston/Columbia Point




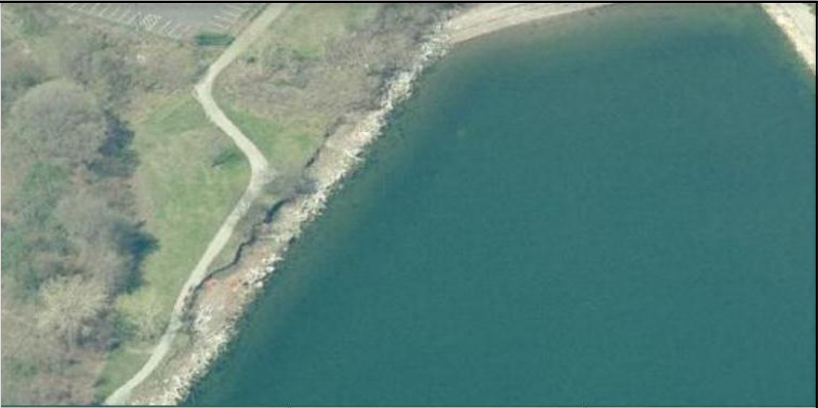
Mean Higher High Water (MHHW) Timeline	Annual (1-year) Storm Surge Timeline	100-year Storm Surge Timeline	Approximate Maximum Water Surface Elevation (ft, NAVD88)	Upland Flooding Potential	Engineering Adaptations	Estimated Adaptation Cost*
2010			4.0	Poor Drainage of Bayside Expo Parking areas during heavy rainfall events. No Flooding of areas from Dorchester Bay waters.	Minor flood proofing of structures Installation of a pump house and pumped based-drainage system for parking area ⁺	Capital Cost: \$ 2.0 Million Annual Maintenance Costs: \$ 10,000
2050			5.0			
			6.0			
			7.0			
2100	2010		8.0	Flooding of Bayside Expo areas from Dorchester Bay. Water overtops harbor walk in places.	Modular seawall installation at critical locations along Harbor walk. Seawall extension along Harbor walk as needed.	Capital Cost [#] : \$1.0-1.5 million (1,000 foot length) Annual Maintenance Costs: \$15,000
	2050		9.0			
			10.0			
			11.0			
	2100	2010	12.0	Widespread flooding of UMASS Boston Campus, Morrissey Blvd. and surrounding areas	In addition to adaptations above, additional flood proofing and elevation of critical infrastructure. Evacuate during storm event and return.	Capital Cost: \$20 per square foot of building for wet flood proofing.
		2050	13.0			
			14.0			
			15.0			
		2100	16.0			



What is vulnerable now?

				Morrissey Boulevard			Mt. Vernon Street		
Mean Higher High Water (MHHW) Timeline	Annual (1-year) Storm Surge Timeline	100-year Storm Surge Timeline	Approximate Maximum Water Surface Elevation (ft, NAVD88)						
				Upland Flooding Potential	Engineering Adaptations	Estimated Adaptation Cost*	Upland Flooding Potential	Recommended Engineering Adaptations	Estimated Adaptation Cost*
			4.0						
2010			5.0	No Flooding Expected	No Action Required	N/A	No Flooding Expected.	No Action Required	N/A
			6.0						
2050			7.0						
	2010		8.0	Flooding of Morrissey Blvd. approx 1/4 mile south of campus entrance. No flooding of campus entrance or facilities			Area has experienced poor storm water drainage. Storm water outfall at 2010 MHHW elevation may not adequately drain in future.	Improve storm water removal and drainage lines. Modify storm water outfall or add pump house.	Capital Cost: \$ 250,000 Annual Maintenance Costs: \$ 2,000
			9.0						
	2050		10.0	Flooding of campus entrance. Initially from Patten's Cove (tidal pond to the west of entrance), and subsequently from Savin Hill Cove.	Tidal control structure at entrance to Patten's Cove. Soft solution (beach nourishment and vegetation enhancement) along Savin Hill Cove.	Capital Cost: \$500-750,000 Annual Maintenance Costs: \$10,000			
		2010	11.0	Widespread flooding of UMASS Boston Campus, Morrissey Blvd. and surrounding areas	In addition to adaptations above, additional flood proofing and elevation of critical infrastructure. Evacuate during storm event and return.	Capital Cost: \$20 per square foot of building for wet flood proofing.	Widespread flooding of UMASS Boston Campus, Morrissey Blvd. and surrounding areas.	In addition to adaptations above, additional flood proofing and elevation of critical infrastructure. Evacuate during storm event and return.	Capital Cost: \$20 per square foot of building for wet flood proofing.
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		2050	16.0						

When will there be flooding?

				Morrissey Boulevard			Mt. Vernon Street		
Mean Higher High Water (MHHW) Timeline	Annual (1-year) Storm Surge Timeline	100-year Storm Surge Timeline	Approximate Maximum Water Surface Elevation (ft, NAVD88)						
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	2010		7.0	Flooding of Morrissey Blvd. approx 1/4 mile south of campus entrance.			Area has experienced poor storm water drainage. Storm water outfall at 2010 MHHW elevation may not adequately drain in future.	Improve storm water removal and drainage lines. Modify storm water outfall or add pump house.	Capital Cost: \$ 250,000 Annual Maintenance Costs: \$ 2,000
	2050		8.0	No flooding of campus entrance or facilities					
2100			9.0	Flooding of campus entrance. Initially from Patten's Cove (tidal pond to the west of entrance), and subsequently from Savin Hill Cove.	Tidal control structure at entrance to Patten's Cove. Soft solution (beach nourishment and vegetation enhancement) along Savin Hill Cove.	Capital Cost: \$500-750,000 Annual Maintenance Costs: \$10,000	Flooding from Dorchester Bay via low-lying pathways to the east of Mt. Vernon Ave.	Provide clean fill in low lying areas or increase storm protection with soft coastal engineering solutions.	Capital: \$300-500,000 Annual Maintenance: \$5,000
		2010	10.0	Widespread flooding of UMASS Boston Campus, Morrissey Blvd. and surrounding areas	In addition to adaptations above, additional flood proofing and elevation of critical infrastructure. Evacuate during storm event and return.	Capital Cost: \$20 per square foot of building for wet flood proofing.	Widespread flooding of UMASS Boston Campus, Morrissey Blvd. and surrounding areas.	In addition to adaptations above, additional flood proofing and elevation of critical infrastructure. Evacuate during storm event and return.	Capital Cost: \$20 per square foot of building for wet flood proofing.
		2050	11.0						
		12.0							
	2100	13.0							
			14.0						
			15.0						
			16.0						

Essentials for the Future

- Balance “robustness” with “flexibility”
- Include “no-regret” and “co-benefit” solutions
- Favor “resilience” over “resistance”

Spaulding Rehabilitation Hospital



Spaulding Rehab

Spaulding Rehabilitation Hospital, Charlestown Navy Yard, Boston

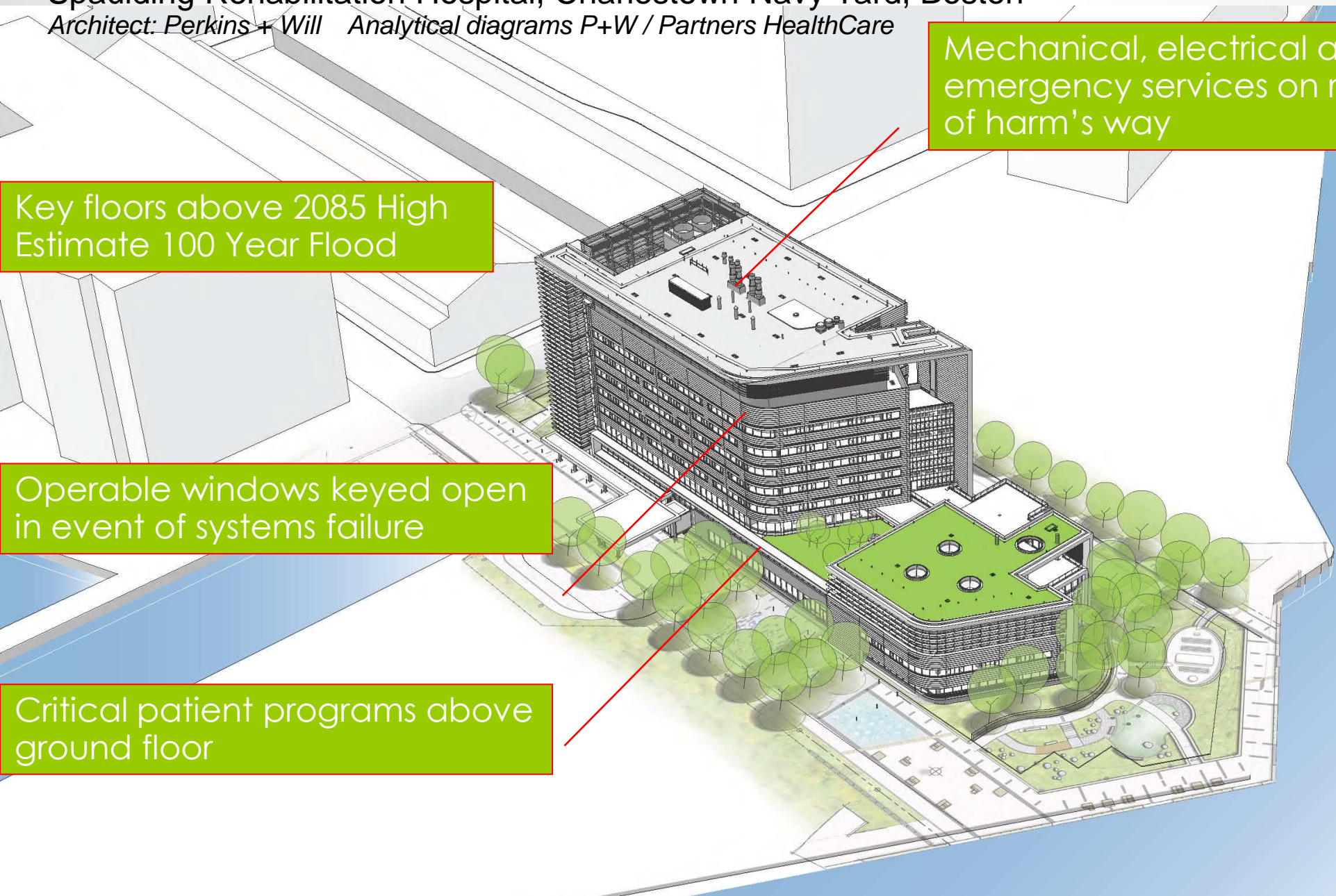
Architect: Perkins + Will Analytical diagrams P+W / Partners HealthCare

Mechanical, electrical and emergency services on roof out of harm's way

Key floors above 2085 High Estimate 100 Year Flood

Operable windows keyed open in event of systems failure

Critical patient programs above ground floor



Summary of Findings

- Today's 100-year flood could be 2050's annual flood and 2100's high tide.
- Private sector can and should develop building-specific preparedness plan
- Vulnerability assessments should integrate resilient adaptation methods
- Public sector should help property owners overcome barriers, step in when private action is insufficient
- No-Regret, Co-Benefit, Flexible and Robust



Thank You

tbha.org/preparing-rising-tide-report

